(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
16 December 2004 (16.12.2004)

PCT

(10) International Publication Number
WO 2004/110000 A1

(51) International Patent Classification[7]: H04L 12/66, H04J 3/16, H04L 12/56

(21) International Application Number: PCT/NO2003/000183

(22) International Filing Date: 5 June 2003 (05.06.2003)

(25) Filing Language: English

(26) Publication Language: English

(71) Applicant *(for all designated States except US)*: **TELEFONAKTIEBOLAGET LM ERICSSON (publ)** [SE/SE]; S-164 83 Stockholm (SE).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **MOLDESTAD, Terje** [NO/NO]; Mørchs Bakke 5, N-4839 Arendal (NO). **HEIMDAL, Per, Eirik** [NO/NO]; Toraldåsen 67, N-4886 Grimstad (NO). **NJØLSTAD, Halvard, Widerøe** [NO/NO]; Egstien 4A, N-4615 Kristiansand (NO). **VEGGE, Berner** [NO/NO]; Vegge, N-4580 Lyngdal (NO).

(74) Agent: **OSLO PATENTKONTOR AS**; Postboks 7007M, N-0306 Oslo (NO).

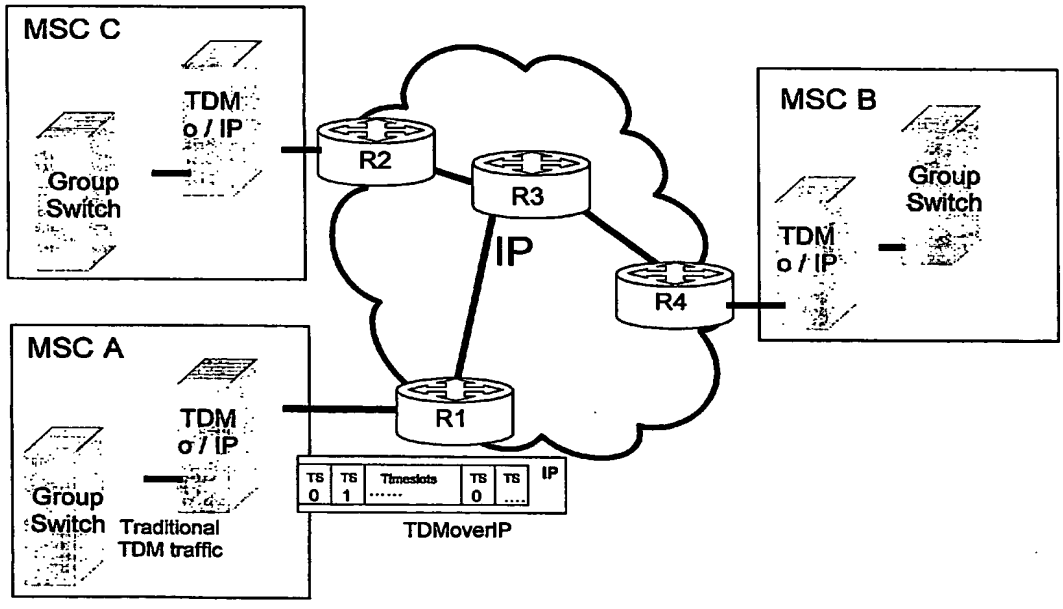
(81) Designated States *(national)*: AE, AG, AL, AM, AT (utility model), AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ (utility model), CZ, DE (utility model), DE, DK (utility model), DK, DM, DZ, EC, EE (utility model), EE, ES, FI (utility model), FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK (utility model), SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*
— *with amended claims*

[Continued on next page]

(54) Title: BANDWIDTH REDUCTION WITHIN PACKET SWITCHED NETWORKS BY NOT SENDING IDLE TIMESLOTS



(57) Abstract: The present invention describes a method in telecommunication networks where time division multiplexing traffic is transported over packet switched networks comprising one or a number of transmitting parties where the transmitting party will not send idle timeslot data on the transporting network. In one preferred embodiment will the transmitting party provide information regarding which timeslot hat are not used. Said telecommunication network can preferably be a packet switched network, wherein the packet switched network is one of the following: an IP-network, MPLS, ATM or Frame Relay.

WO 2004/110000 A1

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

BANDWIDTH REDUCTION WITHIN PACKET SWITCHED NETWORKS BY NOT SENDING IDLE TIMESLOTS

Field of the invention

The present invention is related to telecommunication networks and in particular to methods where time division multiplexing traffic is transported over packet switched networks comprising one or a number of transmitting parties, and one or a plurality of receiving parties.

Background of the invention

The invention is applicable where the Time Division Multiplexing technique (TDM) is used on the site and a packet based protocol, i.e. the Internet Protocol (IP), is implemented in the transport network between the sites. Traditionally TDM (Time Division Multiplexing) traffic is today transmitted directly over SDH (Synchronous Digital Hierarchy) networks. However, it is assumed that tomorrow's telecom transport network will be *packet based*, but probably with a long reuse time of existing site equipment.

Many vendors believe that the future network protocol will be the Internet Protocol (IP). With the introduction of this network technology for real-time applications, telecom companies may get a dilemma. On one hand they want to adapt to the new technology, on the other hand they have a lot of equipment like MSC (Mobile Switching Centre); BSC (Base Station Controller) etc. working very well with circuit switched technology. Buying a complete new packet based solution right away and to phase out circuit switched equipment will be very expensive. Another possibility is to maintain circuit switched and packed switched networks in parallel, but this may also be regarded as too expensive. Facing the fact that the operator on long term probably will implement packet-based transport solutions anyway, i.e. the Internet Protocol (IP), a wanted solution is a mechanism that allows the Telecom Company to use today's

equipment such as MSCs, BSCs etc. towards a packet switched network as an intermediate solution. Then in a later step, when the packet based technology is considered mature for real time applications on site, the change to an "all packet switched" scenario could be regarded reasonable. A problem when transporting TDM over packet based networks is the bandwidth utilization in the transport network. With Time Division Multiplexing, the connections are separated in timeslots. Depending on the traffic load situation, there will be a variable numbers of timeslots not carrying any traffic (they are IDLE). Even though there are timeslots not carrying traffic, these timeslots are today filled with a so-called "Idle Pattern", "Idle pattern" is a fixed bit pattern and it is used in synchronous systems where there can not be any "holes" in the data stream, and transmitted through the network.

A draft to the Internet Engineering Task Force (IETF) describing the concept TDM over IP has been posted. (TDM over IP, Yaakov (Jonathan) Stein et al. March 2003) In this draft there is also a suggestion as to what the protocol stack could look like. The mentioned drafts have no option for dynamic IP bandwidth reduction. There are methods for transporting parts of a trunk (24/32 timeslots), but in a more static way. The described method is rather complicated, introducing a lot of extra overhead etc.

This invention describes a solution to avoid the transmission of the timeslots carrying Idle Pattern and hence reducing the average size of IP packets transmitted. The IP bandwidth reduction requires that information is being sent from the transmitting party to the receiving party, about which timeslots are, at a given moment, not carrying traffic. Equipment existing today provides information about whether a timeslot contains traffic or not.

The present invention uses this information to avoid transmitting timeslots not carrying traffic.

The invention introduces a method for reducing the total amount of data transmitted in a system where traditional TDM circuit switched data are transported over a packet switched network. This will bring a better utilization of the network resources.

Summary of the invention

It is an object of the present invention to provide a system/device and method that eliminates the drawbacks described above. The features defined in the claims enclosed characterize this method.

Brief description of the drawings

In order to make the invention more readily understandable, the discussion that follows will refer to the accompanying drawings.

Figure 1 shows an example where the invention is applied. Figure 2 shows the organization of the transmitted data in ETSI 32ch standard.

Detailed description of preferred embodiments

The major achievement for the present invention is the reduced need for bandwidth, due to the fact that a transmitting party will not send idle timeslot data on the transportation network, but only signal to the receiving party which timeslots are not used, hence there will be increased bandwidth utilization in the transport network.

In one embodiment of the invention, as depicted in figure 1, a scenario with TDMoIP is shown. At MSC A, traditional TDM traffic comes from the Group Switch. Today this traffic goes to an Exchange Terminal (ET) before it is sent out on the SDH network. The invention uses the "TDMoIP" Exchange terminal, which can encapsulate TDM traffic into IP

packets. From TDMoIP the data is sent to the packet router R1 communicating with MSC A. Through the IP network, MSC A can communicate with both MSC B and MSC C which are connected through routers R4 and R2 respectively. The invention requires that the TDMoIP units receive signalling information on which timeslots are idle. In figure 1, both MSC A and MSC C have to communicate with MSC B through router R3. If the invention is used, it could in this scenario i.e. ease the work for router R3, avoiding queue and dropped packets due to fewer/shorter IP packets. In general the invention is particularly useful for the intermediate routers, and the more hops the more favourable is the invention.

The principle of the packet based, i.e. IP, bandwidth reduction is that the transmitting party will signal which timeslots are not carrying any traffic. These timeslots would, without this invention, carry the "Idle pattern" and hence block this capacity for other users. The idea is to remove the "idle pattern" data from the payload and only *signal* that this timeslot is not carrying any user traffic. Arriving at the destination in the transport network, the packet-based bearer will be terminated. The incoming data will, upon some signalling bits, find out which timeslots are not transmitted. The receiving party will then insert the "Idle pattern" into the data stream at the right position. This will happen at the point where i.e. the Internet Protocol (IP) is terminated. The original circuit switched data are then reproduced.

To reproduce the original data stream, the receiving site will insert the "Idle Pattern" data into the stream based on the signalling from the transmitting party. Information about which timeslots are transmitting "Idle Pattern" data is i.e. available as an "Idle Pattern Flag" in the DL34 interface from the Ericsson Group Switch on site. It must be noted that according to the standards, the transmitting party cannot remove timeslots from the data stream based on

analyses of the data stream itself because the transmitted data could accidentally be identical to the "Idle Pattern". The unused timeslots should be removed based on information from the signalling in the system (i.e. from Group Switch or ISUP).

The signalling part can be solved in different ways depending on the standard used. The 32-channel ETSI (European Telecommunication Standards Institute) standard, timeslot 0 (TS-0) contains some free bits, marked as Sa in the figure 3. It is also possible to use other bits in TS-0 as many of them have fixed values not representing any information value (sync), as it is known that the data arrive when the IP packet has arrived. For this standard, TS0 will always have to be present in the data stream.

For the 32-channel solution depicted in figure 2, 31 bits are needed to signal which timeslots are idle, it is not necessary to signal for TS-0, as this timeslot is always used. Table 1 shows the standardized content of timeslot 0. There are 20 free bits (Sa-bits) in one sub multi-frame. In order to signal for 31 timeslots, 2 sub multi-frames are needed. This means that Sa4 in Frame 1 in Sub multi-frame 1 will i.e. be used to signal whether timeslot 1 is idle or not. Sa5 in Frame1 will i.e. be used to signal whether timeslot 2 is idle or not etc. As one cannot signal for all timeslots in every frame, there could be some delay/losses before the far end notices that a given timeslot is idle/not idle anymore. The exact number will be 16 frames, each of 125 microsecond's duration, totally giving 2 milliseconds delay. Each connection (timeslot) will, theoretically in a "zero delay" system, loose 16 bytes of data. This is normally not critical neither for speech nor for data, as the higher network end-to-end signalling protocols are slower than the process turning Idle Pattern on/off. If it is important not to loose any frames with valid data, it can be implemented with a check for frames containing valid data for a certain timeslot, timeslots

with valid data can then be marked as "not idle" before the multi-frame is sent. The drawback is that a delay of 1ms will be added with such a solution.

Sub Multi Frame	**Frame**	**Bit 1 to 8 in Timeslot 0**							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1	**0**	C1	0	0	1	1	0	1	1
	1	0	1	A	**Sa4**	**Sa5**	**Sa6**	**Sa7**	**Sa8**
	2	C2	0	0	1	1	0	1	1
	3	0	1	A	**Sa4**	**Sa5**	**Sa6**	**Sa7**	**Sa8**
	4	C3	0	0	1	1	1	1	1
	5	0	1	A	**Sa4**	**Sa5**	**Sa6**	**Sa7**	**Sa8**
	6	C4	0	0	1	1	1	1	1
	7	0	1	A	**Sa4**	**Sa5**	**Sa6**	**Sa7**	**Sa8**
2	**0**	C1	0	0	1	1	0	1	1
	1	0	1	A	**Sa4**	**Sa5**	**Sa6**	**Sa7**	**Sa8**
	2	C2	0	0	1	1	0	1	1
	3	0	1	A	**Sa4**	**Sa5**	**Sa6**	**Sa7**	**Sa8**
	4	C3	0	0	1	1	1	1	1
	5	0	1	A	**Sa4**	**Sa5**	**Sa6**	**Sa7**	**Sa8**

	6	C4	0	0	1	1	1	1	1
	7	0	1	A	**Sa4**	**Sa5**	**Sa6**	**Sa7**	**Sa8**

This opens for another way of signalling which timeslots are IDLE. If this new protocol shall be able to handle the bandwidth reduction solution described in this document, some bits must be reserved for this purpose. In the long term this will probably be the best solution and it will be usable for both 24 channel and 32 channel systems.

The invention can be used for all kinds of traffic based on TDM technology that needs to be transported through a packet-based network. Examples of packet based transport networks are IP, MPLS, ATM, and Frame Relay etc. To be able to use the bandwidth reduction, there must be some indication (i.e. from the Group Switch or other signalling) available as to which timeslots are filled with Idle Pattern.

It is also possible to add an extra field in the protocols used for signalling which timeslots are filled with Idle Pattern. The drawback is that whenever there are no idle timeslots, the packet size will be increased due to the introduction of the extra signalling bits.

This principle could be used for any known fixed bit pattern, not only for the Idle Pattern used in the standard TDM telephone systems.

List of abbreviations

ATM	Asynchronous Transfer Mode
BSC	Base Station Controller
ETSI	European Telecommunication Standards Institute
IETF	Internet Engineering Task Force
IP	Internet Protocol
ISUP	ISDN User Part
MPLS	Multi Protocol Label Switching
MSC	Mobile Switching Centre
RFC	Request for Comments
SDH	Synchronous Digital Hierarchy
TDM	Time Division Multiplex
PSN	Packet Switched Network

Patent claims

1. Method in telecommunication networks where time division multiplexing traffic is transported over packet switched networks comprising one or a number of transmitting parties
characterized in that the transmitting party will not send idle timeslot data on the transporting network.

2. Method according to claim 1,
characterized in that the transmitting party provides information regarding which timeslot that are not used.

3. Method according to claim 2,
characterized in that the provided information is transferred by manipulating free bits and/or bits having prefixed values within a data-packet.

4. Method according to claim 3,
characterized in that the manipulated free bits and/or the prefixed valued bits carry information regarding which timeslot are idle or not within a data-packet.

5. Method according to claim 3,
characterized in that the free bits and/or the bits having a prefixed value are chosen from timeslot 0 (TS0) thus TS0 will always be transmitted from the transmitting party,

6. Method in telecommunication networks where time division multiplexing traffic is transported over packet switched networks comprising one or a number of receiving parties
characterized in that the receiving party will insert idle pattern data into a receiving data stream.

7. Method according to claim 6,
c h a r a c t e r i z e d i n that information on where to insert idle pattern is found by looking at the bit value on a set of predefined bit positions within the data stream.

8. Method according to claim 7,
c h a r a c t e r i z e d i n that the predefined bit positions are within timeslot 0 (TS0) within the data stream.

9. Method according to claim 5 and 8,
c h a r a c t e r i z e d i n that the transmitting party is manipulating the sent data stream by removing idle time-slot and setting corresponding free bits and/or prefixed valued bit(s) in timeslot 0 and
the receiving party is inserting idle timeslot into the data stream according to which free bits and/or prefixed valued bits in timeslot 0 that were set by the transmitting party.

10. Method according to claim 9,
c h a r a c t e r i z e d i n that the data stream comprises one or a number of data-packets each with a number of sub-multiframes, comprising a number of frames wherein said frames comprises a plurality of timeslots, and said packet is an IP packet encapsulating TDM traffic.

11. Method according to any of the preceding claims,
c h a r a c t e r i z e d i n that the packet switched network is one of the following: an IP-network, MPLS, ATM or Frame Relay

AMENDED CLAIMS

[received by the International Bureau on 22 March 2004 (22.03.04);
original claims 1, 2 replaced by amended claim 1;
original claims 6, 7 replaced by amended claims 6;
claims 3-5, 8-11, renumbered (pages 2)]

1. Method in telecommunication networks where time division multiplexing traffic is transported over packet switched networks comprising one or a number of transmitting parties
c h a r a c t e r i z e d i n that the transmitting party will not send idle timeslot data on the transporting network and the transmitting party provides information regarding which timeslot that are not used.

2. Method according to claim 1,
c h a r a c t e r i z e d i n that the provided information is transferred by manipulating free bits and/or bits having prefixed values within a data-packet.

3. Method according to claim 2,
c h a r a c t e r i z e d i n that the manipulated free bits and/or the prefixed valued bits carry information regarding which timeslot are idle or not within a data-packet.

4. Method according to claim 2,
c h a r a c t e r i z e d i n that the free bits and/or the bits having a prefixed value are chosen from timeslot 0 (TS0) thus TS0 will always be transmitted from the transmitting party,

5. Method in telecommunication networks where time division multiplexing traffic is transported over packet switched networks comprising one or a number of receiving parties
c h a r a c t e r i z e d i n that the receiving party will insert idle pattern data into a receiving data stream. and the information on where to insert idle pattern is

found by looking at the bit value on a set of predefined bit positions within the data stream.

6. Method according to claim 5, c h a r a c t e r i z e d i n that the predefined bit positions are within timeslot 0 (TS0) within the data stream.

7. Method according to claim 4 and 6, c h a r a c t e r i z e d i n that the transmitting party is manipulating the sent data stream by removing idle timeslot and setting corresponding free bits and/or prefixed valued bit(s) in timeslot 0 and the receiving party is inserting idle timeslot into the data stream according to which free bits and/or prefixed valued bits in timeslot 0 that were set by the transmitting party.

8. Method according to claim 7, c h a r a c t e r i z e d i n that the data stream comprises one or a number of data-packets each with a number of sub-multiframes, comprising a number of frames wherein said frames comprises a plurality of timeslots, and said packet is an IP packet encapsulating TDM traffic.

9. Method according to any of the preceding claims, c h a r a c t e r i z e d i n that the packet switched network is one of the following: an IP-network, MPLS, ATM or Frame Relay

1/2

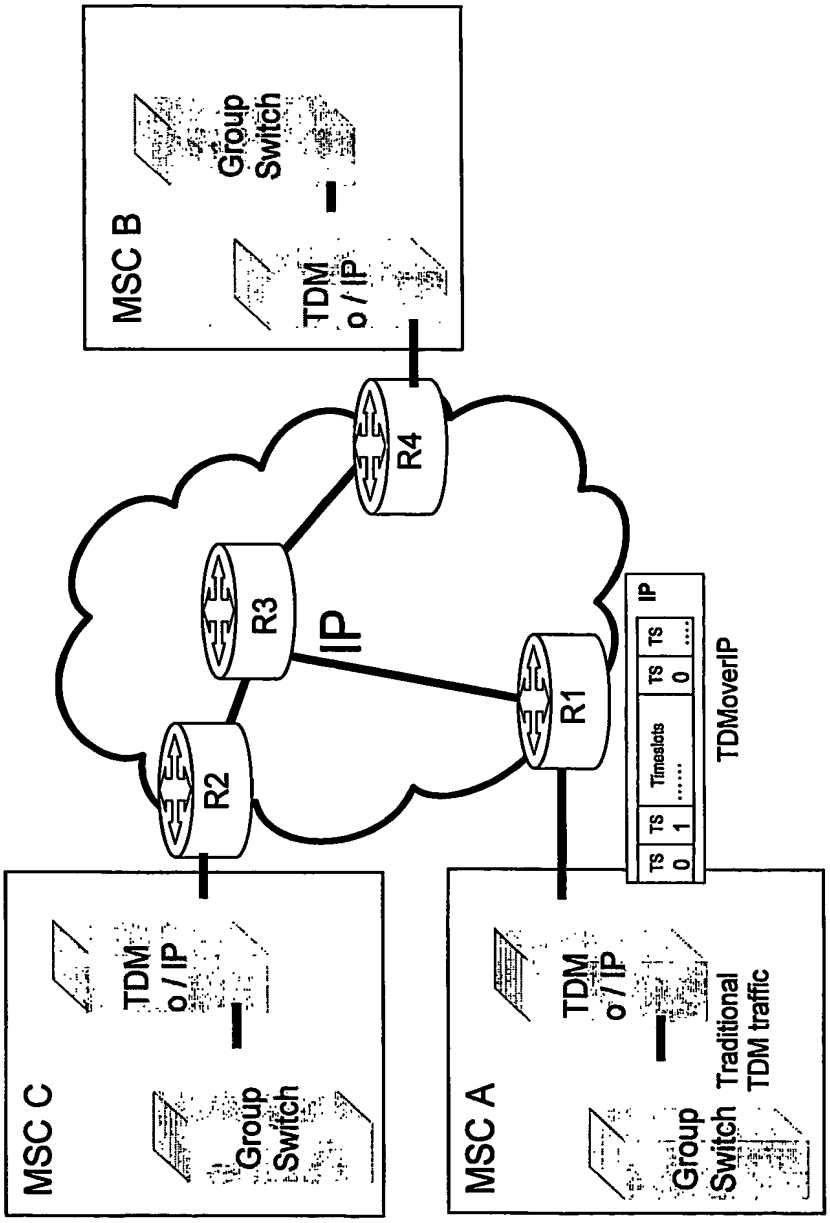


Figure 1: Example of where the invention is applicable

2/2

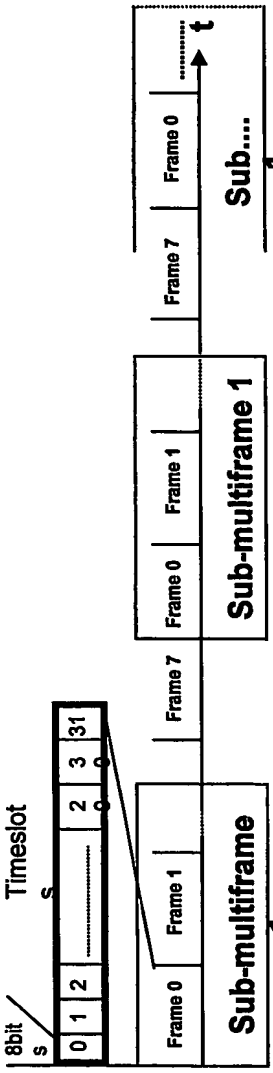


Figure 2: The organization of the transmitted data in ETSI 32ch. Standard

INTERNATIONAL SEARCH REPORT

Internat[redacted] Application No
PCT/NO 03/00183

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04L12/66 H04J3/16 H04L12/56

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04L H04J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 01 47199 A (ERICSSON TELEFON AB L M) 28 June 2001 (2001-06-28) page 1, line 24 -page 2, line 24 page 3, line 9 -page 4, line 5 page 6, line 4 - line 10 page 7, line 10 -page 9, line 12 abstract ---	1-11
X	US 2003/016697 A1 (JORDAN REUVEN D) 23 January 2003 (2003-01-23) paragraph [0025] - paragraph [0026] claims 1,6,16,22,28,29 ---	1-11
X	WO 98 51113 A (NORTHERN TELECOM LTD ;DOLBY RIKI BENJAMIN (GB); JENKINS NIGEL PHIL) 12 November 1998 (1998-11-12) page 12, line 30 -page 13, line 23 --- -/--	1

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
19 December 2003	02 02 2004

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	NABIL SEBAA/MN

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International Application No
PCT/NO 03/00183

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 790 552 A (BATTS MICHAEL DENIS ET AL) 4 August 1998 (1998-08-04) abstract	1
P,X	US 6 633 566 B1 (PIERSON JR FORREST L) 14 October 2003 (2003-10-14) column 3, line 44 -column 4, line 15 claims 1,5,9,16; figure 5 abstract	1-11
A	WO 97 08838 A (AUTRY GEORGE M IV ;LUTTRELL EDWARD N (US); RODERIQUE WILLIAM J (US)) 6 March 1997 (1997-03-06) page 6, line 25 -page 8, line 17 page 24, line 1 -page 25, line 15 abstract	1-10

INTERNATIONAL SEARCH REPORT

Information on patent family members

Internal Application No
PCT/NO 03/00183

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 0147199 A	28-06-2001	SE 520080 C2	20-05-2003
		AU 2416301 A	03-07-2001
		CN 1413402 T	23-04-2003
		WO 0147199 A1	28-06-2001
		SE 9904695 A	22-06-2001
US 2003016697 A1	23-01-2003	WO 03009502 A2	30-01-2003
WO 9851113 A	12-11-1998	AU 7221198 A	27-11-1998
		EP 0979566 A2	16-02-2000
		WO 9851113 A2	12-11-1998
		US 6038231 A	14-03-2000
US 5790552 A	04-08-1998	DE 69418763 D1	08-07-1999
		DE 69418763 T2	11-11-1999
		EP 0618706 A2	05-10-1994
		ES 2132337 T3	16-08-1999
		GB 2276518 A ,B	28-09-1994
		JP 3396852 B2	14-04-2003
		JP 7007514 A	10-01-1995
US 6633566 B1	14-10-2003	NONE	
WO 9708838 A	06-03-1997	AU 6721096 A	19-03-1997
		WO 9708838 A2	06-03-1997